THE SURVEY LINK CONNECTING THE TRIANGULATIONS OF INDIA AND RUSSIA.[1]

AT the meeting of the International Geodetic Association held in London in 1909 the way was cleared for the completion of a connecting link between Indian and Russian triangulations which would carry scientific measurement from Cape Comorin to Petrograd. This necessitated the extension of a geodetic series across some of the highest and most unapproachable of the snow-capped ranges in the northern Himalayan system. Between Gilgit and Salisbury Peak on the Nicolas (Russian spelling) range of the Pamirs there intervene about 100 miles of inconceivably wild and rugged mountain country distinguished by groups of peaks running to altitudes of more than 20,000 ft. and seamed with a most amazing series of waterways containing the biggest glaciers in the world. Salisbury Peak, near the western end of the Pamir boundary between Russia and Afghanistan, looks southwards across the valley of the river Ab-i-Panja (flowing westward to the Oxus and skirting the southern foot of the Nicolas range) on to the great ridge of the Hindu Kush. From the Hindu Kush southward to the Gilgit river flow three great mountain streams, which afford the only possible approaches northward, *i.e.* the Yasin, the Ashkuman, and the Hunza.

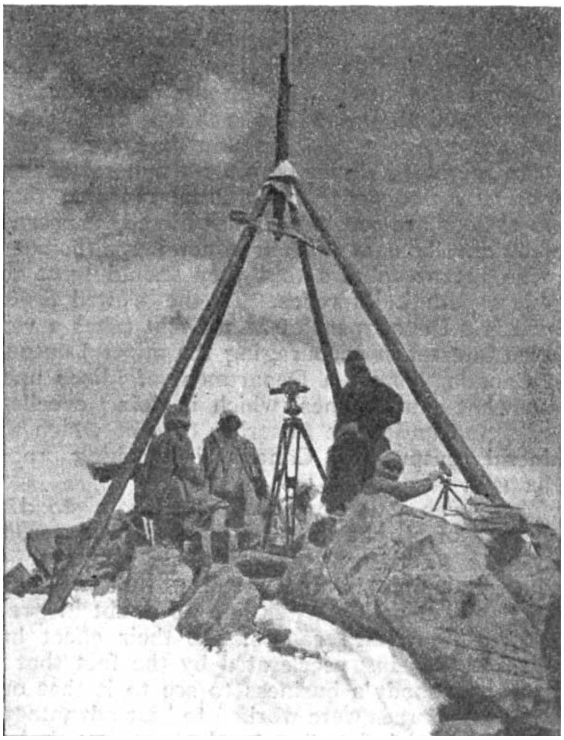

FIG. 1.—On the Russian East Station of Sarblock, 17,284 ft. From "Records of the Survey of India."

Setting aside, for the present at any rate, any consideration of making this geodetic connection through Afghanistan or Persia (which, for political reasons chiefly, is out of the question), the choice of an approach to the Russian boundary in the Pamirs lay between these three most difficult routes. The line of the Hunza was eventually selected as leading more directly to a point on the Russian border close to the Chinese frontier, and involving no question of crossing the valley of the Ab-i-Panja, which, lying low between the Nicolas range and the Hindu Kush, is a narrow strip of Afghan territory. Between 1909 and 1911 a series of principal triangulation had been carried from Rawal Pindi to Gilgit, thus furnishing a first-class base from which to take off for this northern extension. At the other end of the line two trigonometrical stations had been fixed by the Russian surveyors at the eastern end of the Little Pamir, not far from the Beyik Pass, which offered the necessary points for final connection.

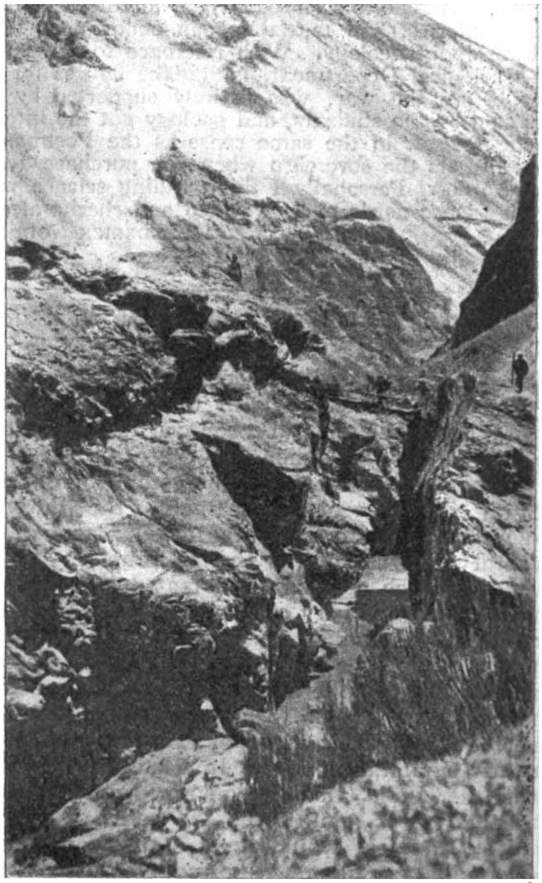

FIG. 2.—A log bridge over the Chapursān. From "Records of the Survey of India."

The report under review deals with the efforts of the Indian Survey officers to bridge this gap and reach commanding observation points in the barren and rugged *entourage* of the Hunza Valley, by means of which a geodetic series could be carried successfully to the Hindu Kush. Probably no scientific surveyors in the world have ever been faced with quite such a problem. The difficulties were not merely those of mountaineering and excessive altitude or of narrow valleys flanked by gigantic mountain walls. These regions are subject, *inter alia,* to storms of great violence and suddenness, and it was during one such storm that the camp of a native assistant was struck and his whole party practically put out of action. The roads, or mountain tracks, which lead to the passes of the Hindu Kush have often been described by travellers, and there is no indication in this report that they have improved of late years. Certainly no very great trouble was caused by the nature of the transport requisitioned. All sorts and conditions of men were impressed into service. The regular native staff of the Survey Department and the trained Gurkha assistants drawn from the frontier regiments were all trustworthy under any conditions of stress and difficulty, whilst the coolie carriers, who were chiefly recruited from the Baltis, were quite satisfactory. Lieut. Mason's appreciation of their services is pleasant reading, and speaks well for his tact and consideration in dealing with natives.

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[1] "Records of the Survey of India." Vol. vi., "Completion of the Link connecting the Triangulations of India and Russia, 1913." Prepared under the direction of Sir S. G. Burrard. (Dehra Dun, 1914.) Price 4 rupees or 6*s*.

It was, on the whole, the technical difficulty of selecting sites for stations of observation, and the incessant demand for strenuous exertion in climbing mountains which possess absolutely no attraction beyond that of the grandest and most savage scenery in the world, which hindered the progress of the party; and it was the successful facing of these difficulties which rendered the completion of this series such a brilliant achievement among the great records of Indian triangulation.

The work in the Pamir highlands was laid out by Lieut. Bell, R.E., whose sudden death ere the work was completed was deeply felt by the whole party. The linking up of two magnificent systems of triangulation, such as those of India and Russia, which would give a continuous and unbroken geodetic system of earth measurement through sixty degrees of latitude, has ever been a most fascinating objective to the scientific geodesist in India, Russia, and England; but whether a narrow series such as this, with uneven sides and angles as factors in the successive figures, will fully satisfy the requirements of geodesy may be questionable. Some of the sides of the figures are very short, restricted by narrowness of the Hunza Valley, and the angles are far from fulfilling the condition of equality in arc. It is, therefore, not claimed for it by the Surveyor-General of India that it represents anything more than a "secondary" series, and it still remains for geodesists to say how far it has succeeded in fulfilling the high scientific requirements that were anticipated from its completion. Incidentally, however, it has been of the greatest practical use, for it has confirmed the values determined by the measurements of the Pamir Boundary Commission in 1895, and proved that the process then adopted of interpolation from distant and definite peaks (which were already fixed by the Indian triangulation on the Gilgit frontier), supported by a constant repetition of observed azimuths, was accurate to a degree which seems to have been unexpected by the present Survey Staff in India, although the coincidence in final values causes no

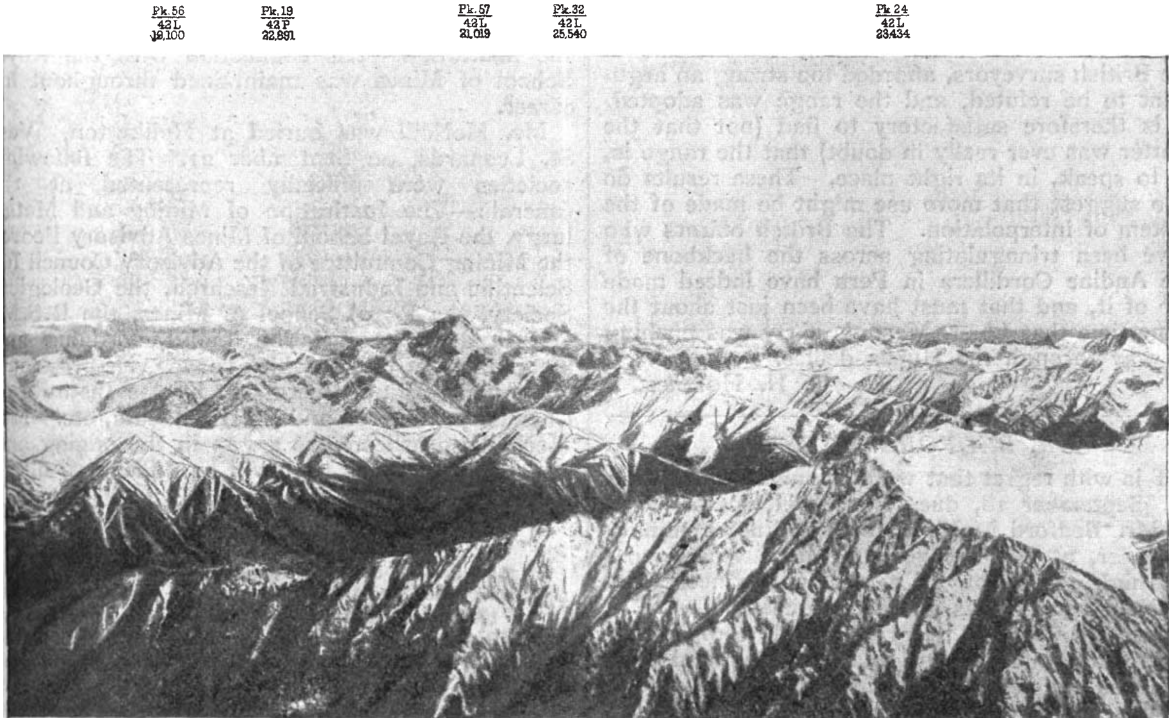

FIG. 3.—The distant Karakoram Range from Tomtek, h.s. 18,608 ft. From "Records of the Survey of India."

surprise to those who were concerned in that Commission work. Roughly, it may be said that the Commission values obtained in the course of a month or two by the method referred to are in excess of those now fixed by about two seconds of arc both in latitude and in longitude, a displacement which has no effect whatever on the validity of that international boundary which was then demarcated.

This is not unimportant, for it need be no longer a political secret that the adoption of the crest of the Nicolas range as the boundary in question depended on the fact that no part of it was north of the latitude of Lake Victoria. The Russians, by astronomical deduction, maintained that it did in fact bulge over that parallel, but the results of the Pamir triangulation, based on those mighty peaks which were visible from certain high altitudes overlooking the Hindu Kush, combined with astronomical determinations for latitude of the British surveyors, afforded too strong an argument to be refuted, and the range was adopted. It is therefore satisfactory to find (not that the matter was ever really in doubt) that the range is, so to speak, in its right place. These results do also suggest that more use might be made of the system of interpolation. The British officers who have been triangulating across the backbone of the Andine Cordillera in Peru have indeed made use of it, and that must have been just about the same time that Lieut. Mason's party was pushing its way through the Hunza defiles.

T. H. HOLDICH.

MR. BEDFORD MCNEILL.

IT is with regret that we announce the death on September 18, due to cerebral hæmorrhage, of Mr. Bedford McNeill, the well-known mining engineer, at fifty-five years of age. Apart from his high reputation as a mining engineer, Mr. McNeill's name was almost a household word in connection with the telegraphic code compiled by him, which was issued originally in 1893, and in an enlarged and revised form in 1908. This code is employed almost without exception by mining companies and engineers, to whose use it was specially dedicated, and other business men have found it extremely practical for cable communications.

As a mining engineer Mr. McNeill graduated at the Royal School of Mines in 1880, when the school was still in Jermyn Street; and his professional career as consulting engineer, which began in the office of the late Mr. John Darlington, took him into many parts of the world. He was a member of many learned societies, including the Institute of Chemistry, the Geological Society, of which he was also a Member of Council and Treasurer for some years, and the Iron and Steel Institute. In 1895 Mr. McNeill was elected a member of the Institution of Mining and Metallurgy, of which he soon afterwards became vice-president, and he occupied the presidential chair in 1913–14. His inaugural address in that capacity dealt with the present and future problems confronting the mining profession, particularly as regards the speculative nature of mining and its close association with capital. He pointed out that mining was likely to become more speculative in its character in the future, since, though there were still large areas not yet properly prospected, the engineer may ultimately be driven to working that class of mineral occurrence which presents no visible evidence whatever at surface, and the location and working of which will inevitably demand higher technical skill and involve greater risk of loss of capital than those deposits at present dealt with. During Mr. McNeill's term of office the Institution of Mining and Metallurgy acquired its freehold house at No. 1 Finsbury Circus, which was formally opened on January 13, 1914, by the Lord Mayor of London, and during his presidency also the first steps were taken for securing the Royal Charter which has since been granted to the institution. His connection with the Royal School of Mines was maintained throughout his career.

Mr. McNeill was buried at Hollington, West St. Leonards, on September 21. The following societies were officially represented at the funeral:—The Institution of Mining and Metallurgy, the Royal School of Mines Advisory Board, the Mining Committee of the Advisory Council for Scientific and Industrial Research, the Geological Society, the Royal School of Mines, the R.S.M. Old Students' Association, and the Mining and Metallurgical Club, of which he was vice-president, while floral tributes were sent by the Institute of Chemistry, the Iron and Steel Institute, etc. Mr. McNeill's death creates a gap in the mining and kindred professions that will be difficult to fill.

NOTES.

AN account of a new means of delineating internal organs *in vivo*, and the localisation of injuries to them, by an electrical method devised by James Shearer, M.D. (Washington, D.C.), at present a sergeant in the R.A.M.C., is given in the *British Medical Journal* for September 30. It is difficult to realise from the description the exact nature of the electrical installation used, but the principle is said to be to impose upon two alternating electric fields of equal strength at right angles the effect of a third field having its origin in the organ under examination. The patient lies on an insulated table, and near him are placed two screens of perforated zinc plate, one horizontal and the other vertical, connected to two separate batteries. A sheet of waxed paper is then put upon a cylinder which is set in rapid rotation, and a needle scribes upon this paper a tracing of the organ under examination, showing at the same time any lesions in it. Prints can afterwards be taken from the record by contact printing with photographic paper. Five illustrations are given in the *British Medical Journal* showing respectively pictures of the brain, kidney, cæcum and appendix, intestine, and liver of injured patients submitted to the process. The brain picture is as clear a delineation of the blood-vessels as is given in text-books of anatomy, but how it could possibly have been produced by a tapping needle upon a rapidly revolving cylinder cannot readily be conceived. Without further details to enable electro-physiologists to repeat Sergeant Shearer's work it is